

WHAT IS CLAIMED IS:

1. A control device for an internal combustion engine, comprising:

an ion current detecting means for detecting an ion current flowing between electrodes, via ions generated in a combustion chamber upon combustion, at a time when a voltage is applied to said electrodes disposed in said combustion chamber of said internal combustion engine;

a parameter extracting means for extracting an ion current characteristics parameter correlating to an IMEP, from said ion current detected by said ion current detecting means;

an IMEP-related-information calculating means for using said ion current characteristics parameter outputted from said parameter extracting means, to calculate information relating to said IMEP of said internal combustion engine; and

an internal combustion engine control means for controlling operations of said internal combustion engine based on said output from said IMEP-related-information calculating means.

2. A control device for an internal combustion engine according to claim 1, wherein said parameter extracting means comprises:

a waveform averaging means for deriving an average waveform averaged from ion current waveforms with respect to a predetermined

number of ignitions detected by said ion current detecting means;
and

first characteristics extracting means for extracting a characteristics of said average waveform outputted from said waveform averaging means.

3. A control device for an internal combustion engine according to claim 1, wherein said parameter extracting means comprises:

a second characteristics extracting means for extracting a characteristics of ion current waveforms with respect to a predetermined number of ignitions detected by said ion current detecting means; and

a characteristics averaging means for averaging a value for said characteristics of ion current waveforms extracted by said second characteristics extracting means.

4. A control device for an internal combustion engine according to claim 2, wherein said first characteristics extracting means comprises:

a filtering means for eliminating noise not related to combustion; and

a range setting means for setting a predetermined range to focus on each characteristics extracted by said first

characteristics extracting means,

wherein information relating to at least one of the following is extracted by said first characteristics extracting means as said characteristics, from signal components passing through said filtering means: a peak value within said range, a range area within said range, and an amount of time that said ion current exceeds a predetermined threshold value within said range.

5. A control device for an internal combustion engine according to claim 3, wherein said second characteristics extracting means comprises:

a filtering means for eliminating noise not related to combustion; and

a range setting means for setting a predetermined range to focus on each characteristics extracted by said second characteristics extracting means,

wherein information relating to at least one of the following is extracted as by said second characteristics extracting means said characteristics, from signal components passing through said filtering means: a peak value within said range, a range area within said range, and an amount of time that said ion current exceeds a predetermined threshold value within said range.

6. A control device for an internal combustion engine

according to claim 1, wherein said IMEP-related-information calculating means comprises:

an IMEP calculating means for calculating said IMEP using said ion current characteristics parameter outputted from the parameter extracting means; and

an IMEP variation rate calculating means for calculating an IMEP variation rate using at least one of outputs from said parameter extracting means and said IMEP calculating means.

7. A control device for an internal combustion engine according to claim 6, wherein said IMEP calculating means comprises first power/coefficient-setting means for setting a power and a coefficient to multiply with said ion current characteristics parameter outputted from said parameter extracting means, in order to calculate said IMEP,

wherein said ion current characteristics parameter outputted from said parameter extracting means is a variable, and said IMEP is calculated as a result of a predetermined linear equation set using said first power/coefficient-setting means.

8. A control device for an internal combustion engine according to claim 6, wherein said IMEP variation rate calculating means comprises:

a parameter variation rate calculating means for calculating

a variation rate of said ion current characteristics parameter outputted from said parameter extracting means; and

a second power/coefficient-setting means for setting a power and a coefficient to multiply with said ion current characteristics parameter variation rate outputted from said parameter variation rate calculating means, in order to calculate said IMEP variation rate value,

wherein the output from said parameter variation rate calculating means is a variable, and said IMEP variation rate is calculated as a result of a predetermined linear equation set using said second power/coefficient-setting means.

9. A control device for an internal combustion engine according to claim 1, wherein said internal combustion engine control means comprises average amount calculating means for calculating an average amount of the output from said IMEP calculating means, and

said internal combustion engine control means controls operations of said internal combustion engine based on an output from said average amount calculating means.